REMARKS

In section 3 of the Office Action, the Examiner rejected claims 15-38 under 35 U.S.C. §103(a) as being unpatentable over the Kennedy patent in view of the Gardner patent.

The Kennedy patent discloses in Figure 4 an adaptive system having first and second antennas 12 and 14, which are used to produce an audio signal by employing an equal-gain combining adaptive control. The adaptive system includes the first and second antennas 12 and 14, an adaptive control 74, a filter 78, and an FM receiver 80.

A summer 76 of the adaptive control 74 sums a RF signal received by the first antenna 12 with a phase adjusted and amplitude modulated RF signal received by the second antenna 14. The RF signal from the second antenna 14 is phase adjusted by a phase shifter 82 and is amplitude modulated by an amplitude modulator 84 at a 38 KHz dither frequency, which is based on a 19 KHz pilot tone detected by the FM receiver 80. Any phase error between the RF signals received by the first and second antennas 12 and 14 results in a phase perturbation of the signal at the output of the FM receiver 80. The

frequency of this phase perturbation is the same as the frequency of the dither tone. Synchronous detection with the original dither tone results in a DC control voltage that is used to control the phase shifting of the RF signal from the second antenna 14. Minimization of the DC control voltage occurs when the two received RF signals are phase-aligned.

Accordingly, the detector output from the FM receiver 80 and the quadrature dither tone output of the device 86 are combined by a multiplier (synchronous detector) 92. Because the outputs of the FM receiver 80 and the device 86 are multiplied together, the phase error between these outputs corresponds to the magnitude of the resulting signal.

The output of the synchronous detector 92 is then connected back to the phase shifter 82 by way of an integrator 90 forming a feedback loop so as null out the phase difference between the two received signals.

Figure 5 generalizes this adaptive system to any number N of antennas.

The Gardner patent discloses the use of binaural synthesis to deliver three-dimensional audio through a pair of loudspeakers or headphones. Head

tacking is implemented in order to enhance the binaural synthesis.

Specifically, Figure 5 discloses a binaural synthesis module (shown as element 100 in Figure 4) and a crosstalk canceller (shown as element 110 in Figure 4) that compensate for head position and angle. An input signal x is processed through left and right cross-coupled channels. The left channel includes a left-channel head-related transfer function (HRTF) filter 200_L, two variable delay lines 205 and 215 that are separated by an adder 245_L, a minimum-phase ipsilateral equalization filter 235_L, a variable gain amplifier 240_L, and a loudspeaker 250_L. The right channel includes a right-channel head-related transfer function (HRTF) filter 200_R, two variable delay lines 220 and 225 that are separated by an adder 245_R, a minimum-phase ipsilateral equalization filter 235_R, a variable gain amplifier 240_R, and a loudspeaker 250_R.

The cross coupling network includes a variable delay line 210 and a left-channel head-shadowing filter 230_L that couple the output of the adder 245_R to a negative input of the adder 245_L. The cross coupling network includes a right-channel head-shadowing filter

230_R that couples the output of the adder 245_L to a negative input of the adder 245_R.

The left-channel and right-channel head-related transfer function (HRTF) filters 200_L and 200_R produce the binaural signal. The variable delay lines 205, 210, 215, 220, and 225 are dynamically changed in response to head position and rotation so as to enhance the binaural signal in response to head position of the listener. The minimum-phase ipsilateral equalization filters 235_L and 235_R provide high-frequency spectral equalization and compensate for the asymmetric path lengths to the ears when the head is rotated. The variable gain amplifiers 240_L and 240_R compensate for attenuation due to air propagation over different distances to the different ears. The left-channel and right-channel head-shadowing filters 230_L and 230_R are also responsive to head position and rotation and model head diffraction.

Independent claim 15 is directed to a method of substantially eliminating a ghost of a received main signal and reducing noise enhancement. The received main signal and the ghost are processed along n paths to produce n processed main signals and n processed ghosts, where $n > 3$. Each of the n paths includes a corresponding finite filter. The processing along each

of the n paths does not substantially eliminate the ghost, and the processing along at least some of the n paths includes shifting data. The n processed main signals and the n processed ghosts are added such that, because of the addition of the n processed main signals and the n processed ghosts, the ghost of the received main signal is substantially eliminated.

There are a number of differences between the Kennedy patent and independent claim 15. For example, independent claim 15 requires processing of the same received signal along n paths. The Kennedy patent, by contrast, discloses that separate signals are processed along n paths. (However, it is noted that the received signal from the antenna 12 is not processed at all upstream of the adder 76, and that any processing that is arguably performed on the received signals from the antennas 14, . . ., N does not include processing by a finite filter.)

That is, as shown in Figure 5 of the Kennedy patent, a first received signal from a first antenna 12 is "processed" along path 1 (although no processing is actually performed along this path), a second received signal from a second antenna 14 is "processed" along path 2 (assuming that phase adjustment and amplitude

modulation qualify as processing), and an n^{th} received signal from an antenna N is "processed" along path N (again, assuming that phase adjustment and amplitude modulation qualify as processing). Each of the signals received by the antennas 12, 14, . . ., N is different because of position and/or orientation. Therefore, the same received signal is not processed along n processing paths as required by independent claim 1.

Moreover, contrary to independent claim 15, the Kennedy patent contains no disclosure that the adder 76 adds n processed main signals and n processed ghosts such that, because of the addition of the n processed main signals and the n processed ghosts, the ghost of the received main signal is substantially eliminated. The Kennedy patent mentions ghosts in only two places. First, in column 1, lines 25-35, the Kennedy patent asserts that a single antenna, such as a car antenna, is generally susceptible to multipath. Second, in column 4, lines 1-4, the Kennedy patent asserts that the adaptive control disclosed therein improves the reception during multipath without introducing any audible modulation artifacts. However, there is no mention in the Kennedy patent that a ghost of a received main signal is

substantially eliminated because of the addition of the adder 76.

Furthermore, as the Examiner has noted, and also contrary to the requirements of independent claim 15, the Kennedy patent discloses no finite filters in the processing paths upstream of the adder 76.

The Gardner patent does not supply these deficiencies. For example, while the Gardner patent does disclose that the signal x is processed along two paths, the left channel and the right channel, the purpose of this two path processing is to produce binaural sound. The Kennedy patent, by contrast, is related to improving reception of a moving receiver. Therefore, there is no suggestion that the two channel processing disclosed in the Gardner patent is of any use to the arrangement disclosed in the Kennedy patent.

Moreover, the Gardner patent does not expressly deal with the problem of ghosts. The Gardner patent does disclose the use of the minimum-phase ipsilateral equalization filters 235_L and 235_R to provide high-frequency spectral equalization and to compensate for the asymmetric path lengths to the ears when the head is rotated. Any ghost reduction that might result from the minimum-phase ipsilateral equalization filters 235_L and

235_R is downstream of the summers 245_L and 245_R and, therefore, does not suggest using the adder 76 of the Kennedy patent to substantially eliminate ghosts.

Furthermore, the only filters described in the Gardner patent as finite filters are the delay lines 205, 210, and 215 which may be implemented as low-order FIR interpolators. These delay lines are upstream of the summer 245_L, downstream of the summer 245_L, and in the cross coupling network. There is no suggestion that such delay lines can be useful in the paths upstream of the summer 76 disclosed in the Kennedy patent.

The Examiner has suggested that the filters 300_L and 300_R are finite filters and that it would be obvious to include these filters in the n paths of the Kennedy patent so as to implement the teachings of the Gardner patent. However, the Gardner patent does not refer to these filters as finite filters. Moreover, the teachings of the Gardner patent are not particularly pertinent to the arrangement disclosed in the Kennedy patent except possibly where the output of the FM receiver 80 is to be provided as a binaural signal. If the output of the FM receiver 80 is to be provided as a binaural signal, the output of the FM receiver 80 in the Kennedy patent would be the signal x in the Gardner patent, such that the

system disclosed in the Gardner patent would be merely connected to the output of the FM receiver 80 disclosed in the Kennedy patent. Such a combination of the Kennedy patent and the Gardner patent would not meet the limitations of independent claim 15.

Accordingly, because there is no suggestion to process the same received signal in the n paths disclosed in the Kennedy patent, because there is no suggestion to use the summer 76 disclosed in the Kennedy patent to substantially eliminate ghosts, and because there is no suggestion to include filters in the n paths upstream of the summer 76 disclosed in the Kennedy patent, independent claim 15 is not unpatentable over the Kennedy patent in view of the Gardner patent.

Independent claim 26 is directed to an equalizer that comprises n processing paths arranged to process the blocks of data, n - 1 data shifters, n finite filters, and an adder. The n processing paths are arranged to process blocks of data. Each of the n - 1 data shifters is in a corresponding one of the n processing paths so that one of the n processing paths has no data shifter. Each of the n finite filters is in a corresponding one of the n processing paths, and each of the n finite filters applies a corresponding set of

finite filter coefficients to the blocks of data. Ghosts of the blocks of data are not eliminated as a result of the application of the sets of finite filter coefficients corresponding to the n finite filters, and n > 2. The adder adds outputs from the n processing paths, and the addition eliminates ghosts of the blocks of data.

As discussed above, there is no suggestion to process the same received signal in the n paths disclosed in the Kennedy patent, there is no suggestion to use the summer 76 disclosed in the Kennedy patent to substantially eliminate ghosts, and there is no suggestion to include filters in the n paths upstream of the summer 76 disclosed in the Kennedy patent.

Accordingly, independent claim 26 is not unpatentable over the Kennedy patent in view of the Gardner patent.

Because independent claims 15 and 26 are not unpatentable over the Kennedy patent in view of the Gardner patent, dependent claims 16-25 and 27-38 are likewise not unpatentable over the Kennedy patent in view of the Gardner patent.

CONCLUSION

In view of the above, it is clear that the claims of the present application are patentable over the art applied by the Examiner. Accordingly, allowance of these claims and issuance of the above captioned patent application are respectfully requested.

Respectfully submitted,

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